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DAA EXPT - 5	

AIM	Greedy approach - Fractional knapsack problem
THEORY	1. The fractional knapsack problem involves selecting a subset of items to place into a knapsack, subject to the constraint that the total weight of the selected items cannot exceed the capacity of the knapsack. 2. Each item has a weight and a value, and the goal is to maximize the total value of the selected items while having a greedy approach towards both- weight and profit 3. The key difference between the fractional knapsack problem and the classical knapsack problem is that in the fractional version, items can be selected partially, i.e., fractions of an item can be placed into the knapsack. 4. In the classical version, items must be either included entirely or excluded entirely. 5. **ALGORITHM :** **a. Start.** **b. Take in the input structure array of items from the user.** **c. Sort the array in descending order of the profit by weight ratio.** **d. Check if weight of the item is less than or equal to the capacity of knapsack.** **e. If less than or equal to, include the complete profit of that item in the overall profit and update the capacity.** **f. If not, take the required fraction of the item and update the capacity to 0** **g. Repeat steps 4 to 6 till the capacity of knapsack becomes zero.** **h. End.**

	6. Time Complexity : i. O(nlogn), where n is the number of items, due to the need to sort the items by value-to-weight ratio.
CODE	

```c
// Knapsack

#include <stdio.h>
#include <stdlib.h>

// structure for an item in the knapsack problem
struct item
{
    int itemId;
    double weight;
    double profitVal;
    double profitByWeightRatio;
};

// function to solve the knapsack problem
int solveKnapsack(struct item items[], int numOfItems,
double capacity)
{
    // sorting the array
    struct item tempItem;
    for (int i = 0; i < numOfItems - 1; i++)
    {
        if (items[i].profitByWeightRatio < items[i +
1].profitByWeightRatio)
        {
            tempItem = items[i];
            items[i] = items[i + 1];
            items[i + 1] = tempItem;
            i = -1;
        }
    }
    printf("\nThe rearranged items based on their profit
to weight ratio are as follows : \n\n");
    printf("Item\tProfit\tWeight\tProfit to Weight
Ratio\n");
    for (int i = 0; i < numOfItems; i++)
    {
        printf("I%d\t%.0lf\t%.0lf\t%.2lf\n",
items[i].itemId, items[i].profitVal, items[i].weight,
items[i].profitByWeightRatio);
    }
```

```
    // selecting the required items as per greedy
approach
    int index = 0;
    double maxProfitVal = 0;
    while (index < numOfItems)
    {
        if (items[index].weight <= capacity)
        {
            maxProfitVal += items[index].profitVal;
            capacity -= items[index].weight;
            index++;
        }
        else if (capacity > 0)
        {
            maxProfitVal += (items[index].profitVal) *
(capacity / items[index].weight);
            break;
        }
    }
    printf("\nThe max profit value as
obtained(considering greedy approach towards both weight
and profit) : %.2lf\n", maxProfitVal);

    return index;
}

// main function
void main()
{

    // taking user inputs
    int numOfItems;
    double capacity;
    printf("\nEnter the number of items to be considered
for knapsack : ");
    scanf("%d", &numOfItems);
    printf("Enter the capacity of knapsack : ");
    scanf("%lf", &capacity);

    // dynamically allocating the memory for array of
items
    struct item *items = malloc(numOfItems *
sizeof(struct item *));


    // taking inputs regarding all the items
    printf("\nEnter the Weight and Profit value of all
the items-\n");
    for (int i = 0; i < numOfItems; i++)
```

```
    {
        printf("Item - %d : ", i + 1);
        items[i].itemId = i + 1;
        scanf("%lf", &items[i].weight);
        scanf("%lf", &items[i].profitVal);
        items[i].profitByWeightRatio =
(items[i].profitVal) / (items[i].weight);
    }

    // solving the knapsack problem
    int index = solveKnapsack(items, numOfItems,
capacity);
    double weightSum = 0;
    printf("Set of items to be included in the knapsack :
{");
    for (int i = 0; i < index; i++)
    {
        printf("I%d, ", items[i].itemId);
        weightSum += items[i].weight;
    }
    if (weightSum < capacity)
    {
        printf("(%.0lf/%.0lf) of I%d}\n\n", capacity-
weightSum, items[index].weight, items[index].itemId);
    }

    // deallocating the used memory
    free(items);
}
```

OUTPUT

```
Enter the number of items to be considered for knapsack : 4
Enter the capacity of knapsack : 30

Enter the Weight and Profit value of all the items-
Item - 1 : 12 30
Item - 2 : 2 90
Item - 3 : 45 7
Item - 4 : 2 0

The rearranged items based on their profit to weight ratio are as follows :

Item    Profit  Weight  Profit to Weight Ratio
I2      90      2       45.00
I1      30      12      2.50
I3      7       45      0.16
I4      0       2       0.00

The max profit value as obtained(considering greedy approach towards both weight and profit) : 122.49
Set of items to be included in the knapsack : {I2, I1, (16/45) of I3}
```

CONCLUSION

By performing the above experiment , I was able to implement Greedy approach for solving.
Ive succefully understood coding Fractional Knapsack problem and its Algorithm.